COMPOSITE BUILDING ELEMENT

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Cited documents:
AU1010947
US4523419
GB1572354
AU5596580
GB2188693
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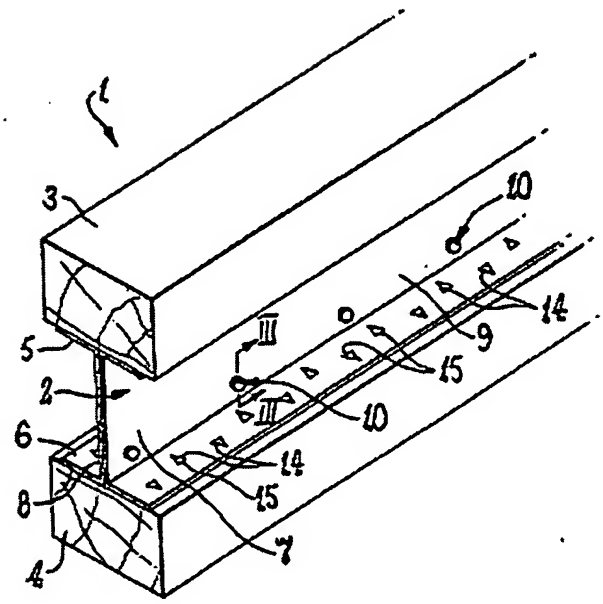
Abstract of **WO8911011**

A composite beam (1) is formed from a steel member (2) and at least one timber member (3, 4) secured to the steel flange or flanges (5, 6) of the steel member (2). The flanges (5, 6) of the steel member (2) have a multiplicity of sharp pointed fastening elements (13) formed along the length thereof, and those elements (13) are embedded in the timber material of the timber members (3, 4) thereby connecting the timber members (3, 4) to the steel member (2) so that the beam performs as a composite beam in use. The steel member may take various forms and may be made up from a plurality of steel plates. The fastening elements (13) are preferably in the form of gang nails integrally connected to the flanges of the steel member (2).



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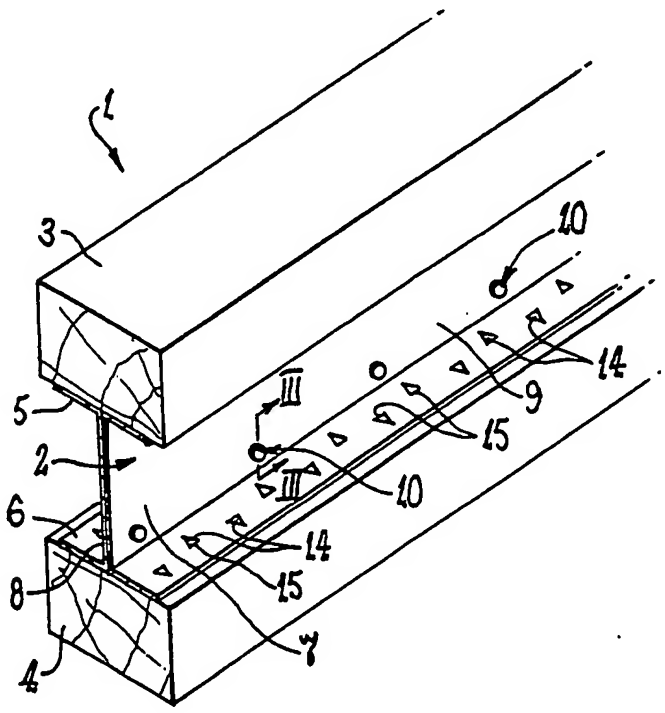

(57) Abstract

A composite beam (1) is formed from a steel member (2) and at least one timber member (3, 4) secured to the steel flange or flanges (5, 6) of the steel member (2). The flanges (5, 6) of the steel member (2) have a multiplicity of sharp pointed fastening elements (13) formed along the length thereof, and those elements (13) are embedded in the timber material of the timber members (3, 4) thereby connecting the timber members (3, 4) to the steel member (2) so that the beam performs as a composite beam in use. The steel member may take various forms and may be made up from a plurality of steel plates. The fastening elements (13) are preferably in the form of gang nails integrally connected to the flanges of the steel member (2).

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Composite Building Element

This invention relates to a composite building element, and more particularly to a composite beam formed of steel and timber. Clearly, although the building element of the invention will generally be used as a beam there will undoubtedly be a variety of different uses for such a building element. In this specification the building element of the invention will be referred to as a beam although that is not its only use.

Composite beams are known in the building industry and are used for various reasons such as relative costs and availabilities of different materials, and relative strengths of materials under differing load conditions. For example, steel and concrete composite beams are often used since concrete is able to withstand substantial compressive stress but not tensile stress, whilst steel is able to withstand tensile stress. By designing a composite beam such that the concrete parts thereof carry the compressive load, and the steel parts thereof carry the tensile load, a saving in steel can be made thereby reducing the cost of the beam. Concrete is, however, advantageous in that it is easily moulded to the form of the steel and, once moulded, bonds to the steel thereby ensuring the composite beam acts as an integral unit.

Materials which do not readily bond to each other are less suitable for forming composite beams since the two different materials must then be joined together using some form of fastening arrangement which requires time and labour and increases the overall cost of the beam. Nuts and bolts, or rivets are used in many such situations, but separate drilling operations and fastening operations are necessary to

manufacture the beam.

Timber beams are used in many situations, particularly domestic building situations, since timber is easily worked, and is relatively inexpensive. Timber is also suitable to have facings affixed thereto by simple screwing or nailing operations. However, timber does have disadvantages since it has a tendency to distort if it becomes wet, or if not properly cured, and the more stable timbers tend to be expensive. Also, in situations where the timber beam is to carry substantial load the size of timber required can become large requiring laminated beams, which are expensive, or large dimension beams which are not always readily available. Timber beams are also usually excessively large for the load they are designed to carry, since the designer is usually obliged to over design the beam to cater for possible strength decreasing flaws which might be present in the timber.

It is an object of the present invention to provide a beam which has at least some of the advantages of composite beams as well as at least some of the advantages of timber beams yet overcomes at least some of the disadvantages of composite beams and timber beams referred to above.

A beam according to the invention comprises an elongate steel member and a co-extending timber member, said steel member having a web portion and a flange portion, a multiplicity of sharp pointed fastener elements being formed along the length of said steel member integral with said steel member, said fastener elements extending in a direction transverse to the plane of said flange portion, said timber member being joined to said steel member by said fastener elements being embedded in the timber material along the

length of the beam so that said timber member is held against said flange portion by said fastener elements, and said timber and steel members act together as a composite beam.

It is preferred that the fastener elements are punched or otherwise cut from the flange portion material whilst remaining integrally joined to the flange portion along one edge of the fastener elements. The beam may be of any suitable cross-sectional form, and specifically envisaged are I-beams, right angle section beams, T-beams, and channel section beams. It will be convenient to herein describe various embodiments of the invention which it is envisaged will be satisfactory in operation.

The following description makes reference to the accompanying drawings which depict the various embodiments. Those drawings, however, are merely illustrative of how the invention might be put into effect, so the specific form and arrangement of the various features as shown is not to be understood as limiting on the invention.

In the drawings:

Figure 1 shows a perspective view of a first embodiment of the invention.

Figure 2 shows an end view of the beam shown in Figure 1.

Figure 3 shows a connection arrangement for connecting together two steel components which make up the steel member of Figure 1.

Figure 4 shows a perspective view of a second embodiment of the invention.

Figure 5 shows an end view of the beam shown in Figure 4.

Figure 6 shows a side view of the beam shown in Figure 4.

Figure 7 shows a perspective view of the steel member of

Figure 4 prior to assembly with its timber members.

Figure 8 shows a perspective view of a third embodiment of the invention.

Figure 9 shows an end view of the beam shown in Figure 8.

Figure 10 shows a perspective view of a steel member for a fourth embodiment of the invention.

Figure 11 shows the steel member of Figure 10 in assembly with upper and lower timber flanges.

Figures 12 to 15 show perspective views of four further embodiments of the invention.

A beam according to the invention can take various forms, and the size of beam, as well as the sizes and thicknesses of materials which make up the beam can vary, depending on the application and design load. The following description refers only to I-section beams, but clearly the invention is not limited to I-beam sections. Channel section T-section, angle sections, box-sections and the like are also envisaged.

Referring to Figure 1, a composite beam 1 is shown comprising an I-section steel member 2 and upper and lower timber member numbered 3 and 4 respectively, secured to the upper and lower flanges, numbered 5 and 6, of the steel member 2. The steel member 2 is formed from steel plate material cold rolled to the form of two channel sections numbered 7 and 8 mounted back to back as shown with the webs 9 of the channel sections in contact with each other. The channel sections 7 and 8 are secured together by a series of integral rivets 10. The form of the rivets is depicted in cross-section in Figure 3 which shows a protrusion 11 from one web extending into the interior of a protrusion 12 in the other web, both protrusions

then being deformed into a flat condition as shown to thereby secure the webs 9 together. As shown, there will be a series of integral rivets 10 along both the upper and lower edges of the webs 9 thereby securely fastening the webs 9 together and ensuring they act as an integral unit in use.

The flanges 5 and 6 of the steel member 2 each have a multiplicity of nails or fastening elements 13 integrally formed therein and extending along the length of the beam. The nails 13 are punched or otherwise cut from the flange material leaving triangular openings 14 in the flanges. The nails 13 remain connected to the flanges along one edge 15 of the triangular form. That edge 15 is preferably parallel with the length of the beam although it is not essential that this be so. The free ends 16 of the fastening elements 13 are sharp so that they will easily embed in the timber material of the timber members 3 and 4. Multiple nails of the aforementioned kind are known as "gang nails" and that term will hereinafter be used to refer to this type of fastening arrangement between the steel member and the timber member or members.

As will be evident from Figure 2 the gang nails may extend in a direction which is perpendicular to the flanges 5 and 6 of the steel member 2. However it is not essential that this be so, and in some applications, for example where lateral forces may be experienced by the beam, it may be preferable for at least some of the gang nails to be set at an angle to the perpendicular. It is preferred that the edge by which individual nails remain connected to the flange material be parallel to the length of the beam, since this arrangement will best carry stress components which are parallel to the

length of the beam.

The arrangement shown in Figures 4 to 6 is somewhat different in that the beam 20 has a steel member 21 having flanges 22, 23 which are themselves of a U or channel shaped configuration. The flanges 22, 23 have edge flanges 24 in which gang nails 25 are formed. The edge flanges 24 are parallel to the plane of the web 26 of the steel member 21 thereby increasing the overall modulus of elasticity of the beam. The timber flanges 27, 28 locate between the edge flanges 24, and the gang nails 25 are embedded in the sides 29 of the timber flanges 27, 28. The web 26 of the steel member preferably has a series of strengthening ribs 30 formed therein. These strengthening ribs 30 may take the form of ridges 31 pressed out of the wall of the web 26, perpendicular to the length of the beam. Where the steel member 21 is formed of two components, as shown, strengthening ribs 30 may be pressed out of each web 26. Also the web may have apertures 32 therethrough through which electrical or other conduit may pass should this be required.

Figure 7 shows the steel member 21 of the embodiment described with reference to Figures 4 to 6, prior to the timber flanges 27, 28 being secured to the steel member. The flanges 22, 23 preferably are formed in a flat condition with the gang nails 25 formed as shown projecting in an upward direction from upper flange 27 and in a downward direction from lower flange 28. The timber flanges 27, 28 are thereafter placed onto the steel flanges and the sides of the steel flanges are folded along fold lines running parallel to the length of the beam indicated by dotted lines 33. As the flanges are folded along dotted lines 33 the gang nails 25

will embed in the timber material of timber flanges 27, 28 thereby forming a good connection between the steel member and the timber flanges.

Figures 8 and 9 depict a further embodiment of the invention. As shown, the steel member 40 is formed as a corrugated length with the corrugations extending in a direction perpendicular to the length of the member. Preferably the form of the steel member which makes up the corrugations is a series of flat sections 41 which form a web of the beam, the flat sections 41 running along the centre line of the beam. The flat sections 41 are integrally joined together by V-shaped rib sections 42. Alternate rib sections 42 project to opposite sides of the flat sections 41 and these rib sections 42 serve to strengthen the web 43 thus formed. The upper and lower ends of the flat sections 41 are folded over at 90^{o} to the plane of the flat sections to form upper and lower flanges, number 44 and 45, for the steel member. The upper and lower ends of every alternate flat section 41 are folded to opposite sides of the beam centre line to keep the beam in balance. The ends 46 of the V-shaped rib sections 42 remain aligned with the plane of the rib sections 42 and are embedded in upper and lower timber flanges, numbered 47 and 48. These ends 46 thus connect the timber flanges 47, 48 to the steel member 40.

A somewhat similar arrangement to that of the previous embodiment is shown in Figures 10 and 11. Figure 10 shows a steel member 50 prior to the timber flanges 51, 52 being fitted thereto. The steel member 50 has a flat plate web 53, and upper and lower steel flanges 54, 55 are formed on the upper and lower edges of the web 53 by cutting a series of

flaps 56 into the steel plate and bending these flaps over at 90° as shown to form the flanges. Alternate flaps 56 are folded to opposite sides of the web 53. The flaps 56 are cut at an angle so that a nail or spike 57 is formed between each flap 56 and the nails 57 so formed are not bent over but remain in the plane of the web 53. Timber flanges 58, 59 are then joined to the steel member 50 by embedding the nails 57 into the timber material along the length of the beam. The nailing operation may be done using any suitable power or other tool. The assembled beam is depicted in Figure 11 of the drawings.

The beams shown in Figures 12 to 15 are similar to those of the previous embodiments except, in each case, the steel member 60 has itself been formed from a number of steel plate components spot welded or otherwise secured together. As shown in Figures 12, 13 and 14 the steel flanges 61 have been formed with a folded spine 63 extending down the centre line of the flanges 61, and that spine 63 is located between two web plates 64, 65 which make up the web 66 of the steel member 60. In Figures 12 and 14 the web plates are simply rectangular plates running the length of the beam, whereas in the Figure 13 embodiment the web plates 64, 65 are formed by two back to back channel sections 67 which clamp the spines 63 therebetween.

The Figure 15 embodiment shows two back to back channel sections 68 joined together with a flange plate 69 joined to each composite flange 70 formed by the channel sections.

In each of the embodiments shown in Figures 12 to 15 the flanges have integrally formed gang nails 71 extending outwardly therefrom along the length of the beam. Those gang

nails are embedded in timber flanges 72, 73 to join the timber flanges to the steel member 60 thereby ensuring the beam operates as a composite beam.

As previously mentioned, it is not essential that the invention be limited to I-section beams. Clearly, the invention is equally applicable to other beam sections as well as being applicable to other arrangements of I-beam sections. Also, as will be evident from the above, various different forms of integral fastening means may be used to connect the timber members to the steel member.

Finally, it is to be understood that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit or ambit of the invention.

CLAIMS:

1. A beam comprising an elongate steel member and a co-extending timber member, said steel member having a web portion and a flange portion, a multiplicity of sharp pointed fastener elements being formed along the length of said steel member integral with said steel member, said fastener elements extending in a direction transverse to the plane of said flange portion, said timber member being joined to said steel member by said fastener elements being embedded in the timber material along the length of the beam so that said timber member is held against said flange portion by said fastener elements, and said timber and steel members act together as a composite beam.

2. A beam according to claim 1 wherein said steel member is formed from a plurality of elongate components joined together.

3. A beam according to either preceding claim wherein said fastener elements are gang nails.

4. A beam according to any preceding claim wherein said flange portion is of U-shaped configuration having edge flanges which are parallel to and extend in a direction away from said web portion, said timber member being located between said edge flanges, said fastener elements being formed integral with said edge flanges and being embedded in the sides of said timber member.

5. A beam according to any preceding claim wherein said beam is of I-section configuration comprising a steel member of I-section configuration and having two timber members, each timber member being connected to a respective flange portion of the I-section steel member, each said flange portion having fastener elements formed along the length thereof which are

embedded in said timber members to join said timber members to said steel member.

6. A beam according to any preceding claim wherein said steel member is comprised of steel plate material and said fastener elements are punched from said plate material, said fastener elements being of substantially triangular form being joined to said steel member along one edge of said triangular form.

7. A beam according to claim 6 wherein said one edge of said fastener elements is parallel to the length of said steel member.

8. A beam according to claim 1 wherein said steel member is comprised of a rectangular metal plate the width of which is small compared with the length thereof, both the long edges thereof having a series of cuts formed thereon extending along the length of said steel member, said cuts being transverse to the length of said steel member, said cuts forming a series of flaps each separated by a fastener element, each flap on both long edges being folded at 90^{o} to the plane of said plate, alternate flaps being folded to opposite sides of said plane, said flaps forming flange portions of said steel member.

9. A beam according to claim 8 wherein said plate has a corrugated cross-section, the axis of the corrugations being transverse to the length of the steel member.

10. A beam according to claim 9 wherein the form of said corrugation is a series of flat sections joined together with rib sections, alternate rib sections projecting laterally to opposite sides of said flat sections, said flaps being integral with said flat sections, and said fastener elements being integral with said rib sections.

11. A beam according to any preceding claim wherein a series of strengthening ribs are formed in said web portion, said strengthening ribs lying transverse to the length of said beam and said strengthening ribs being integral with said web portion.

12. A beam substantially as hereinbefore described with reference to any one of the embodiments shown in the accompanying drawings.

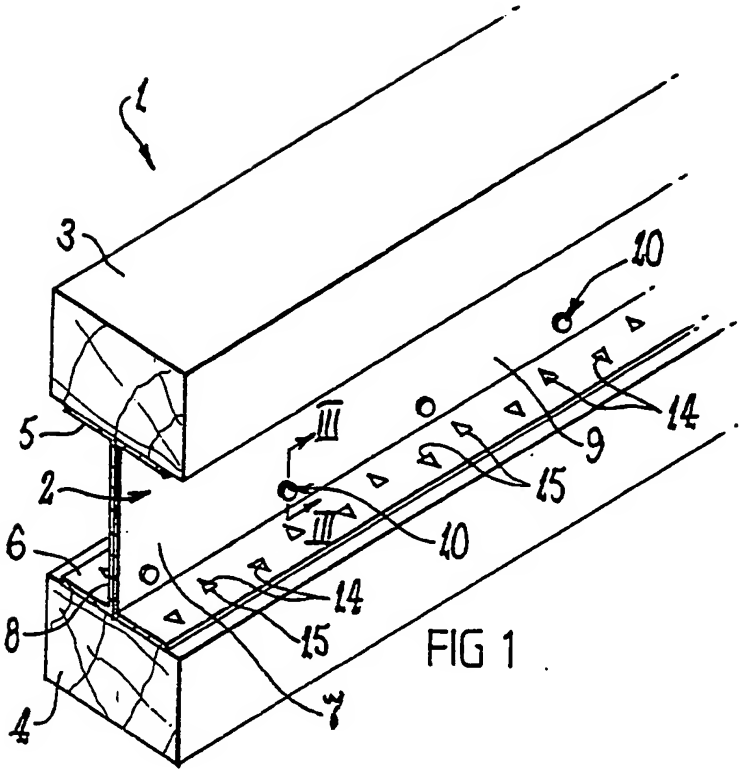

FIG 1

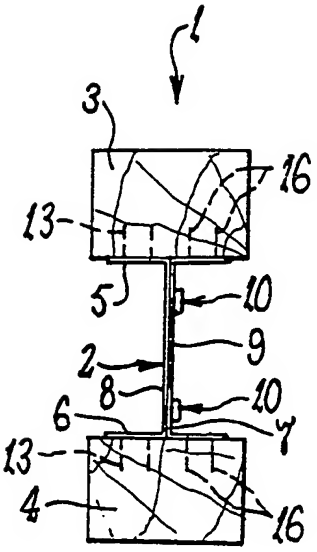

FIG 2

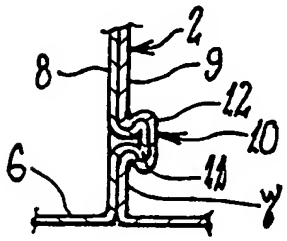

FIG 3

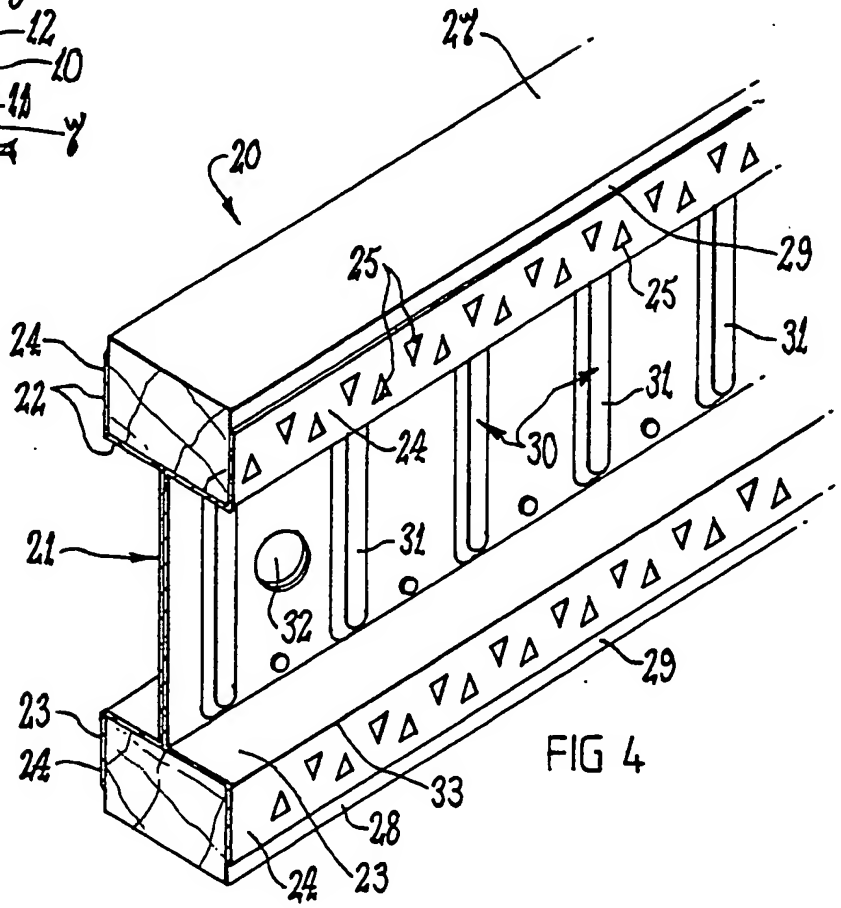

FIG 4

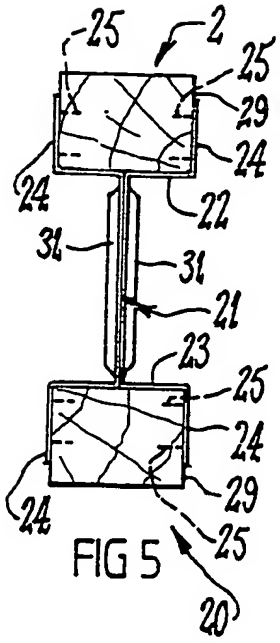

FIG 5

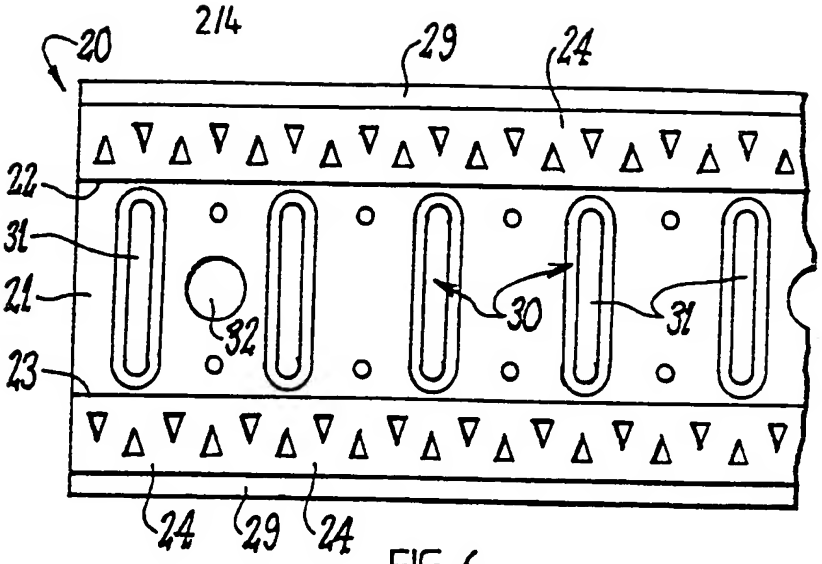

FIG 6

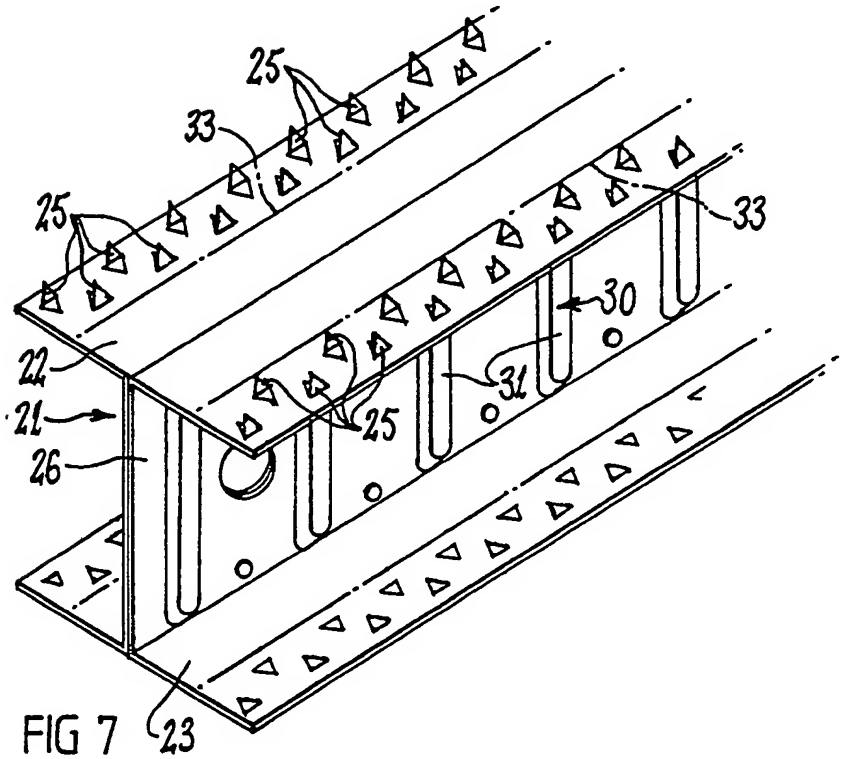

FIG 7

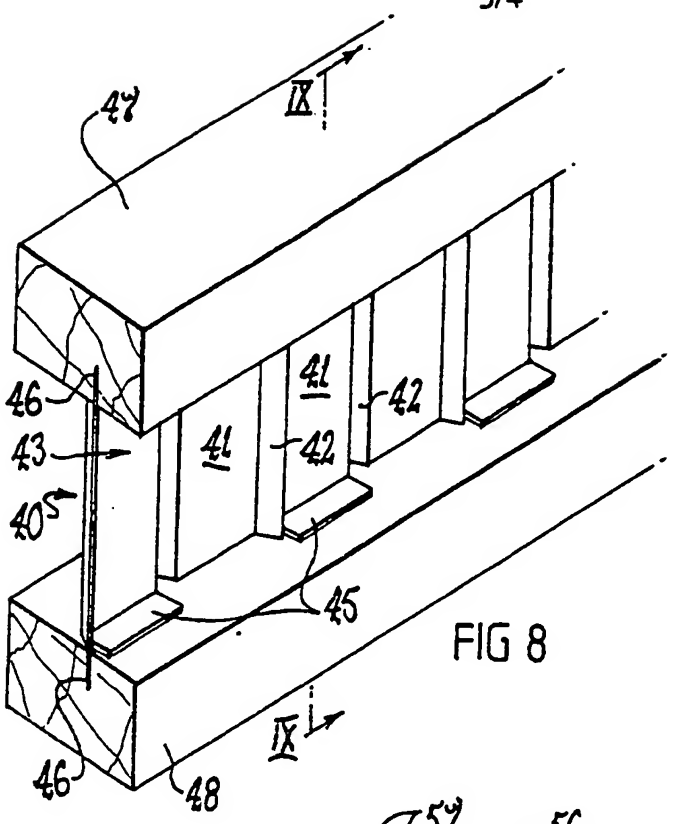

FIG 8

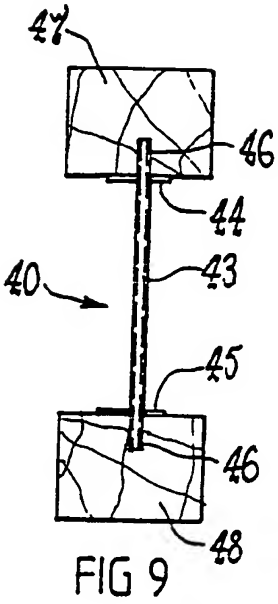

FIG 9

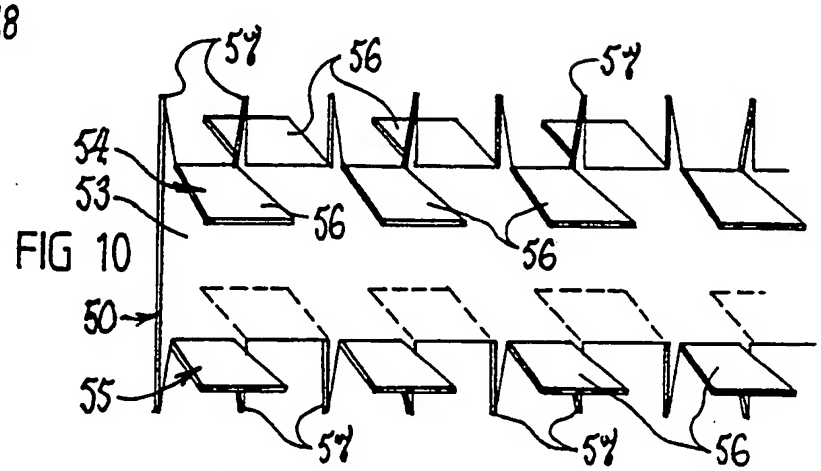

FIG 10

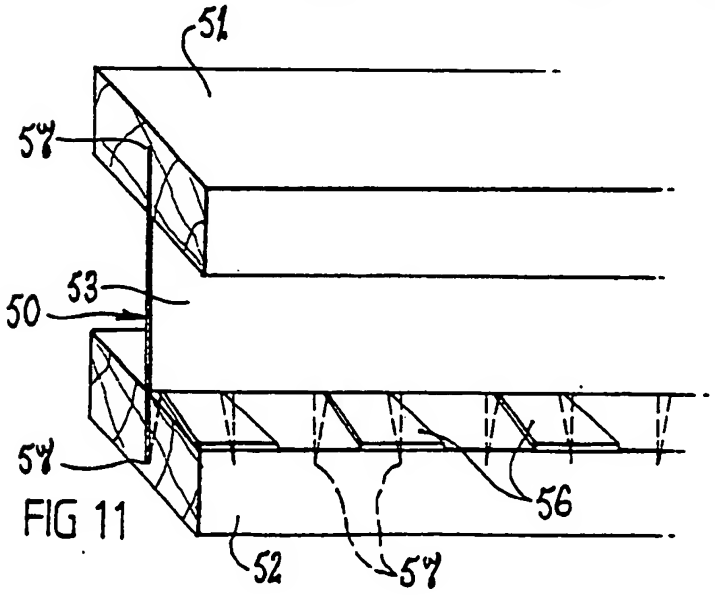

FIG 11

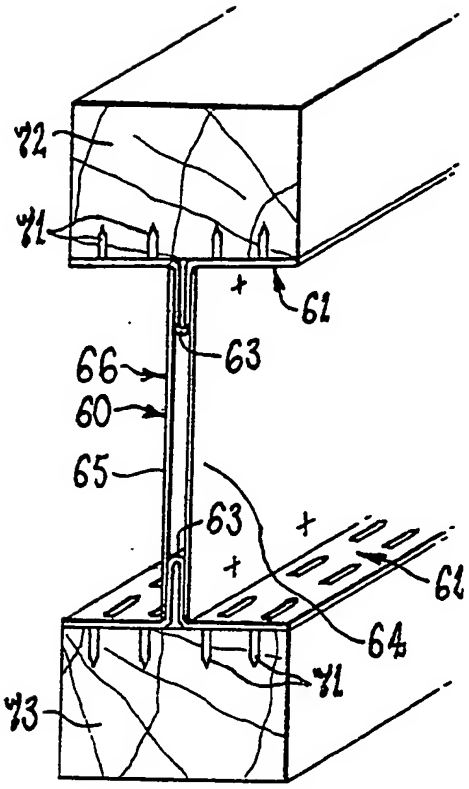

FIG 12

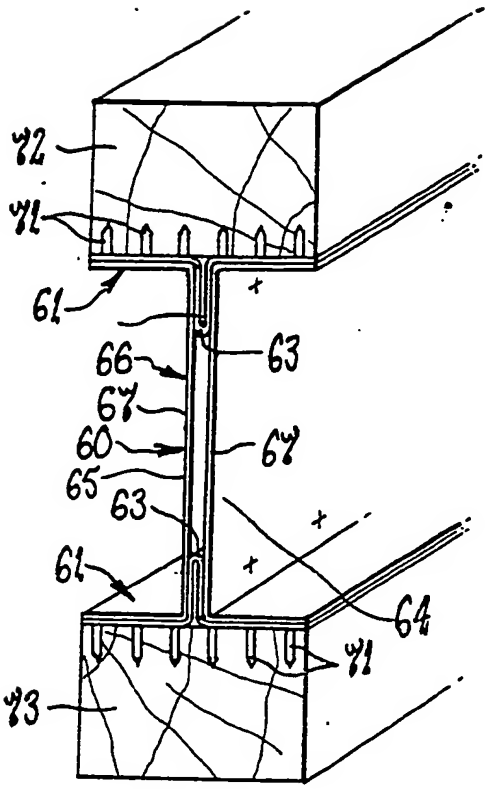

FIG 13

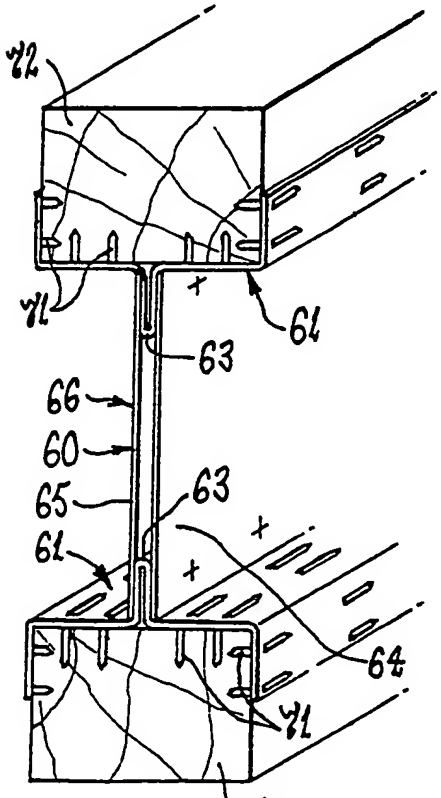

FIG 14

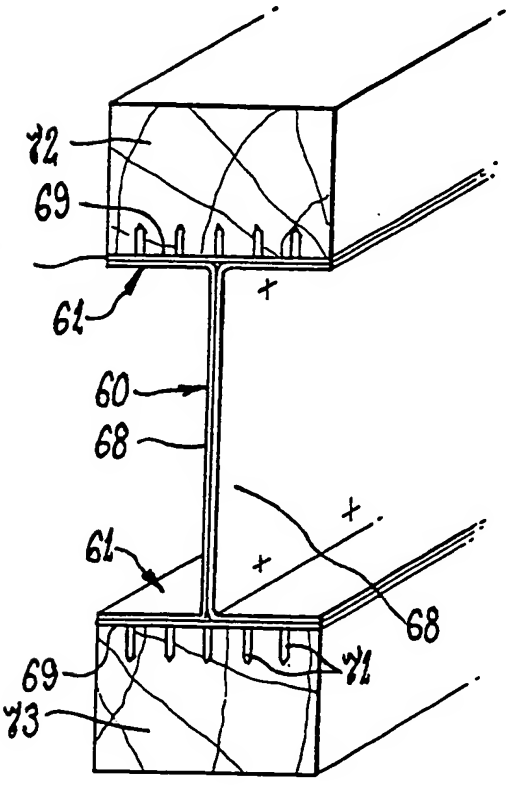

FIG 15

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] E04C 3/292

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	E04C 3/29, 3/292

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X,Y	AU,A,10109/47 (MENDHAM) 24 April 1947 (24.04.47)	(1-11)
X,Y	US,A,4523419 (PALACIO ET AL) 18 June 1985 (18.06.85)	(1-11)
X,Y	GB,A,1572354 (KNOWLES ET AL) 30 July 1980 (30.07.89)	(1-11)
X,Y	AU,B,55965/80 (536967) (FRELENA AB) 4 September 1980 (04.09.80)	(1-11)
X,Y	GB,A,2188693 (METSA-SERIA OY) 7 October 1987 (07.10.87)	(1-11)
X,Y	AU,B,46233/68 (433669) (TRUS JOIST CORP.) 21 May 1970 (21.05.70)	(1-11)
X,Y	AU,A,25640/71 (STIMBER-LITE SALES (PRIVATE) LTD) 24 August 1972 (24.08.72)	(1-11)
X,Y	AU,A,45005/79 (SANFORD) 20 September 1979 (20.09.79)	(1-11)
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X,Y	AU,B,19332/83 (562020) (GANG-NAIL SYSTEMS, INC) 12 April 1984 (12.04.84)	(1-11)
X,Y	AU,B,12329/55 (217470) (PEACOCK) 21 March 1957 (21.03.57)	(1-11)
X,Y	AU,B,21682/45 (125767) (THE TRUSSED CONCRETE STEEL COMPANY LTD) 4 July 1945 (04.07.45)	(1-11)

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14 July 1989 (14.07.89)	21 July 1989 (21.07.89)
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	P. MALANOS ASE

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 89/00194

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
US 4523419	FR 2547875	GB 2142109	JP 60013163
	SE 8401780		
AU 55965/80	BE 881973	CA 1143534	DK 3558/80
	EP 25784	FI 800594	IT 1140709
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	WO 8001297		
GB 2188693	AT 310/87	AU 68737/87	DE 3704596
	DK 743/87	FI 860665	FR 2599069
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AU 45005/79	FR 2420004	US 4143500	
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	GB 2127457	JP 59080849	US 4464885
	US 4525972	US 4570407	US 4665677

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